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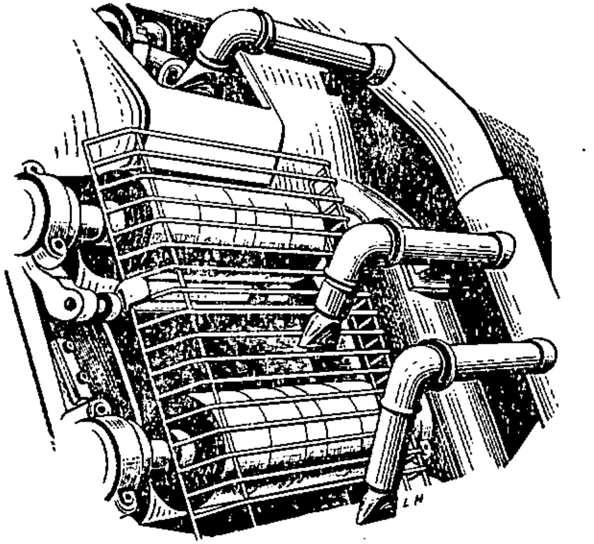

# Changing hands

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# JOURNAL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY

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## EDITORIAL

As is apparent from the minutes of recent Council Meetings, the Institute, along with other interested bodies, has been devoting considerable attention to the establishment of courses of training for chemical technicians and technologists. The Institute has, of course, for many years, through its Laboratory Assistants' Certificate Examinations, realised the need for definite qualifications for which technicians might train and be trained, but there is now strong feeling that considerably more than even a modified L.A.C. is needed. Provided these more highly trained technicians can be absorbed into industry, the Institute as a whole will be behind any move to establish additional qualifications and to provide training for them. The problem in the past has been that while the Institute could set up standards, and examine candidates, it could provide no definite courses of instruction. If, as seems likely, the Education Department will provide the instruction, to an approved syllabus drawn up in collaboration with the Institute of Chemistry, then real progress is being made.

This is however only one facet of a much bigger and wider problem and it seems clear that the Institute and other professional bodies will have to play an equally active part in fostering more adequate scientific teaching, particularly at Post-Primary School level. This subject has been raised so often that it may be regarded as a hobby-horse of the present Editor but the position does seem so serious that no opportunity should be lost of bringing to the notice of all concerned with the scientific future of the country, the dying nature of basic sciences like chemistry and physics in many schools. General science would seem to be in the ascendency. Well taught this subject may have considerable merit but for the academically minded it is no substitute for the discipline of basic sciences. There is a belief, even in this scientific age, that more than one science is too great specialisation; brighter pupils are being "talked out" of science especially in girls' schools; mathematics is dropped with reckless abandon; despite shortages some science teachers must still dissipate their energies on non-scientific subjects.

It is not so much the actual standard of chemistry teaching which we are criticising; *the fault lies in the existence of syllabuses and examination prescriptions which allow basic sciences to be relegated to such minor positions.* Unless the Institute and other interested bodies can attack this real problem at its roots, its efforts in connection with technician and technologist training may well be in vain.


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# MOTOR SPIRIT ADDITIVES.

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*(Based on a lecture delivered to the Wellington Branch in September, 1957.)*

An additive is a substance which is added to or blended with a petroleum fuel or lubricant in order to modify, enhance, or suppress the basic properties possessed by the product in the condition in which it normally emerges from the refining process. Additives may be incorporated in a product before it finally leaves the refiner's hands or may be added in the marketing country immediately prior to issue to the consumer; an example of the latter instance is the blending of tetra ethyl lead into a basic stock in New Zealand in order to produce a particular grade of Aviation Fuel of higher octane rating.

A very considerable volume of technical literature has been published on the use of additives in petroleum products generally, but when one compares some of the more extravagantly worded advertising claims regarding motor spirit with the available technical data, it is not surprising that there exists a certain scepticism as to their real merits. This scepticism, healthy as it may be, should not be allowed to obscure the fact that the use of additives is now well established on good scientific grounds, and that they do play a vital part in the application of petroleum products, both fuels and lubricants. As information of this nature relating to the petroleum industry is by no means easy of access it is hoped that this article may help to clear up some of the apparent mysteries and perhaps misunderstandings which surround the subject.

Motor Spirit additives may be broadly grouped under six main headings:—

1. Upper cylinder lubricants.
2. Dyestuffs.
3. Oxidation inhibitors and metal deactivators.
4. Anti-knock compounds.
5. Combustion chamber deposit modifiers (e.g. pre-ignition preventers).
6. Anti-carburettor icing substances.

Of these by far the most important are 3, 4 and 5 and consequently the greater part of this article will be devoted to them; comparatively brief mention will be made of the other three categories.

## *UPPER CYLINDER LUBRICANTS*

As the name implies, additives to motor spirit in this category are intended to supplement the normal cylinder wall lubrication system by introducing into the combustion chamber oily materials dissolved in the spirit, and subsequently (in theory at any rate) deposited on the cylinder walls when a charge of vapourised fuel is drawn into the cylinder on the downward or suction stroke of the piston. In addition some measure of positive lubrication is provided for inlet valve stems and carburettor moving parts.

Many different types of lubricants, both liquid and solid, have been marketed for this purpose, the most popular being a light mineral oil, sometimes made to look attractive by the addition of a distinctive dye. Fatty acids, or other fatty compounds, have also been marketed, their oily properties being enhanced by the strongly polar nature of their molecules, which tends to impart good adherance to metallic surfaces (iso-propyl oleate, for example). Colloidal graphite, that much overworked substance, has also been used for this purpose.

The value of upper cylinder lubricants has been the cause of considerable controversy in the past, and perhaps the best that can be said for their use is that if they did no good, they did no harm. When one considers that the amounts used are usually well under 1% by volume, and that the state of division on introduction to the cylinder is extremely high, resulting in practically instantaneous combustion with the firing of the fuel, the amount of lubricant remaining to condense on, or adhere to the walls of the upper part of the cylinder becomes extremely small, and hence of questionable efficacy.

Since the advent of modern types of so-called detergent crankcase oils, with their vastly superior metal-wetting properties as compared with the now outmoded straight mineral oils, there no longer exists any real justification for the use of upper cylinder lubricants. Modern crankcase oils do not drain away completely from cylinder walls on long standing, but leave a lasting film of tenaceously adhering oil which has banished the old bogey of the "dry start."

## *DYESTUFFS*

In motor and aviation spirits, oil soluble dyes of various colours are used for several reasons—firstly to impart an attractive appearance, secondly to provide a clear indication that the fuel contains tetra ethyl lead, and thirdly, (in the case of aviation spirits) to provide obvious evidence to distinguish between the different grades according to their octane rating (blue for 91/96, green for 100/130, purple for 115/145). It was originally a requirement of the Ethyl Corporation that lightly leaded motor spirit grades had to be coloured yellow, while grades above a certain tetra ethyl lead limit had to be coloured red. Nowadays this requirement does not exist, and different colours of motor spirits cannot be taken to imply different lead contents. The dye itself is introduced as a constituent of the Octel fluid (originally called Ethyl fluid), and the basic motor spirit colour is now orange. In concentration, the amount of dye is very small, and hence entirely harmless, being between 1 and 3 mgms per imperial gallon. Although there is no restriction as to type of dye in motor spirit, relevant armed service specifications limit the dyes to be used in aviation spirit to:—

Blue—an alkyl substituted amino anthroquinone;

Yellow—$\alpha$-dimethyl-amino-azobenzene;

Red—methyl derivatives of azobenzene-4-azo-2-naphthol.

*OXIDATION INHIBITORS*

In the early days of the petroleum industry when motor fuels consisted entirely of straight run distillates (i.e. products obtained by simple distillation) troubles due to the formation of gummy oxidation products during storage were rarely encountered, but following the development of the thermal cracking process, to meet the demand for higher anti-knock fuels, the resulting spirits which contained a fairly high proportion of olefinic or unsaturated hydrocarbons showed a tendency to deteriorate in storage, particularly under the severe conditions encountered in warm or tropical zones. As a result of such storage it was found that gummy materials were eventually produced in the fuel and such gum formation, if allowed to develop unchecked, led to adverse effects upon engine operation such as the sticking of inlet valves in their guides and the deposition of non-volatile resinous materials in the fuel feed system, the carburettor, and the inlet manifold.

The word gum is generally used in the petroleum industry in the sense of a solid or semi-solid non-volatile substance which remains as a residue when the volatile constituents of the spirit are removed by evaporation, and which may be deposited from solution at ordinary temperatures if a sufficient amount accumulates to exceed its comparatively low solubility limit. Two types of gum are usually recognised, namely existent and potential gum, the former term referring to material which is present in the fuel at the time of test and the latter denoting the amount of gum which is likely to be formed upon storage; the respective amounts of potential gum and existent gum do not necessarily bear any relationship one to the other. The amount of existent gum in a fuel is determined in the laboratory by a straight-forward evaporation test, usually assisted by a jet of air, and the amount of residue remaining after the evaporation has been completed both on the water bath and subsequently in a drying oven is weighed quantitatively, the result being expressed as so many milligrams per 100 mls of fuel. Normal amounts of gum determined in this way range from 1 to 5 mgms per 100mls. The determination of potential gum is somewhat more complex and involves a bomb test with or without the use of a catalyst. After the fuel has been subjected to the bomb test its gum is then measured as before and the amount of increase obtained provides a rough guide to subsequent stability of the fuel upon long term storage.

The deterioration of a motor spirit in storage leading to the formation of gum is mainly due to the oxidation of olefines, and the initial stages of such deterioration appear to be the formation of peroxides from conjugated diolefines, which induces a chain reaction mechanism leading ultimately to the formation of aldehydes, ketones, acids, gums and other reaction products. Such oxidation is eventually accompanied by a darkening of colour of the motor spirit and may involve the separation of the gum as a heavy oil; a motor spirit which is in an advanced stage of gum formation very frequently possesses a smell resembling that of varnish.

The control of gum formation can be carried out to a large extent at the refinery by the removal of unstable portions of the motor spirits during the normal refining processes, but this frequently involves substantial operating costs and it is often better, from the economic point of view at any rate, to add a suitable anti-oxidant or inhibitor rather than carry the refining to an advanced stage. In the case of aviation gasolines, where of course quality standards are of the highest, it is mandatory in terms of Ministry of Supply specifications that inhibitors be used, and minimum concentrations are actually written into such specifications. In New Zealand, however, as in most other countries today, troubles due to the formation of gum in motor spirit are most rare, if indeed they actually exist, chiefly because our storage conditions are comparatively mild and furthermore turnover is usually so rapid that fuels do not undergo long periods of storage.

Many compounds have been employed commercially as inhibitors including those based on aromatic hydroxyl, amino, and alkyl groups, most of these being directed at the overall inhibiting of oxidation. During the period when the marketing of water white gasoline was of importance prior to the last war, other inhibitors were included for the sole purpose of stabilising colour and these were usually of the aliphatic amine type of compound. Some of the most important inhibitors in current use today for motor spirits are n-butylparaaminophenol, and butylphenylenediamine, and for aviation spirits three different types are authorised; these are: 2, 6-ditertiary-butyl-4-methyl-phenol, n, n'-disecondary - butyl - para-phenylenediamine, 2,4-dimethyl-6-tertiary-butyl-phenol. These inhibitors are chosen not only for their normal anti-oxidant properties but also because they possess the very desirable characteristic of preventing the decomposition of tetra-ethyl lead. In general, inhibitors need only be added in very small quantities, something of the order of 0.001 to 0.05% by weight and there is usually an upper limit to the amount which can be usefully employed. Under some circumstances, particularly when motor spirit has been sweetened by one of the copper chloride methods, it is necessary to provide a metal deactivator to eliminate the oxidation catalysis effect of any trace amounts of metal remaining in the motor spirit. One such metal deactivator is disalycil-propylenediamine.

Since the end of the last war there has been a marked increase in the use of catalytically cracked motor spirits as distinct from the older thermally cracked products and such components possess very much greater storage stability on the whole so that the problem of gum formation upon storage is by no means as troublesome as previously.

## *ANTI-KNOCK COMPOUNDS*

Probably the most important property of motor spirit today is its anti-knock value which is measured in terms of octane numbers. It is because of the progressive elevation of the octane numbers of motor spirit over the years that the modern car has been able to achieve its astonishing increase in performance compared with its earlier forbears. Perhaps the most important factor in its improved performance has been the better knowledge and control of the combustion process which, in the earliest motor cars, was only barely understood. As far back as the early years of this century, research workers discovered that combustion problems were most complex and it was at Cambridge University in 1905 that Prof. Hopkinson carried out combustion studies which first recognised the difference between detonation and preignition. Research started in 1916 by a group of men connected with General Motors (headed by Kettering and including Midgley and Boyd) was the beginning of an immense amount of prolonged investigation, which is still going on, by several organisations both British and American, with the object of observing and explaining the phenomena that occur in a spark ignition engine during combustion and of influencing them in a favourable direction. Improvements in the anti-knock value of motor spirit have been brought about in several ways, not only by developments in refinery processes but also by the suitable blending of two or more constituents to produce a balanced fuel, but even with these developments it is debateable whether the fuel quality improvement could have proceeded as far as it has today without the use of tetra ethyl lead. Certainly the development would not have been so rapid. In the researches which have taken place there has been a never-ending quest for substances which could be used to control detonation or knocking and a glance at the patent literature under this heading shows that hundreds of such compounds have been proposed, but in spite of this evidence of the results of intensive research, only one substance, namely tetra ethyl lead, has achieved prominence and permanence.

The first anti-knock agent, whose discovery was more or less due to chance, was iodine. Midgley was investigating the reason for kerosine being inferior to motor spirit in resistance to detonation and thought that the difference was connected with volatility. He reasoned that if his theory was correct, the addition of a dye to the kerosine might make the partly dispersed droplets absorb radiant heat and thus vapourise early in the combustion process. He tried iodine in the kerosine and found that the "knock" disappeared; thus encouraged, he used a number of oil-soluble dyes without success. After returning to iodine, this time in the form of colourless ethyl iodide, which also stopped knock, he realised that his colour theory was unsound, but that he now had proof that detonation was a chemical problem and must be attacked as such.

Subsequently Midgley became enthusiastic about the use of amines, such as aniline and its derivatives, but later still found that diethyl telluride was much more effective than any of his previous compounds; however diethyl telluride had one serious drawback in that, when minute quantities were inhaled or absorbed through the skin there resulted unpleasant symptoms such as "a strong garlic-like odour given off from every pore of the body and affecting everything and everyone with whom the victim came in close contact." This did not deter Midgley in the slightest—he merely said that just so soon as the entire population became infected, the problem would disappear, since the victims would soon be unable to detect the odour. Perhaps therefore we have to be thankful for the development of tetra ethyl lead in more ways than one.

Eventually, in 1921, as a result of Midgley being shown a new chart of the periodic system in which the elements were arranged according to both their electro-positive and electro-negative properties, he found that the anti-knock properties of various agents could be related primarily to the properties of the major element and to its position in the periodic table. This rearranged chart was responsible for Midgley trying the various organo metallic compounds, and after finding that tin tetrachloride was effective, discovered that tetra ethyl tin was more effective still. It was after a further series of experiments with similar compounds of the heavier metals that he hit upon tetra ethyl lead, which at that time was purely a chemical curiosity and had not been made outside the laboratory.

As a result of the very great deal of work which has been put into the study of the phenomenon of detonation, it is now common ground among all workers in this field that the immediate cause of knock is the extremely rapid combustion of the last part of the charge to burn. The occurrence of knock appears to depend on the temperature-pressure-time relationship of the mixture in the 'end-gas.'

Detonation is thought to be due to a chain reaction being set up in the combustion process after burning has progressed in a normal manner up to a point where the temperature and pressure produced by the advancing flame front accelerates the rate of reaction to a critical value. (A normal flame front advancing at 50/60 feet per second accelerates to 500/1000 feet per second under detonating conditions). At this stage the reactions tend to become auto-catalytic, in that they are catalysed by the formation of organic peroxides, and unless some inhibition takes place by an anti-knock agent, the inflammability of the end-gas is so enhanced as to give rise to violent uncontrolled combustion. When this occurs, the rate of pressure rise within the cylinder head increase rapidly and attains a very high value; pressure waves are set up, which, on striking the combustion chamber walls, give rise to the familiar metallic knocking or pinking sound. The anti-knock action of such materials as tetra ethyl lead lies in their ability to prevent the initiation of a high rate of acceleration of the flame front during the latter stages of the combustion by interferring with the reactions leading up to the chain mechanism.

Although tetra ethyl lead is such an excellent anti-knock agent, it was soon found, in the early researches which brought it into being, that when the pure substance (which is a colourless liquid of density 1.6 and a boiling point of 200°C) was used by itself it rapidly built up deposits of lead oxide in the combustion chamber, causing fouling of valves and sparking plugs after only a very few hours operation. It was then necessary to embark upon further intensive research to find a chemical compound which would combine with the tetra ethyl lead decomposition products during the combustion process and act as a scavenger. Eventually Midgley found that ethylene dibromide was suitable in forming compounds of lead and bromine which are volatile and are evacuated with the exhaust gases. Later a mixture of ethylene dibromide and ethylene dichloride was substituted commercially, partly on economic grounds as the chlorine compound is the cheaper, but even today ethylene dibromide is used alone in aviation gasolines. Since, as with other chemical reactions of a like nature, the process in the engine cylinder is not perfectly complete, some products inevitably remain in the form of deposits, although fortunately the efficiency of the reaction is such that these products do not begin to introduce deleterious effects until a distance equivalent to several thousands of miles has been covered. Further reference to this deposit formation will be made later in dealing with the next class of motor spirit additives.

The composition of the commercial anti-knock compound which consists mainly of tetra ethyl lead and which is commonly known as Octel Fluid is as follows (for comparison the composition of the aviation compound is shown against that of the motor spirit compound).—

| | Aviation Compound % by weight | Motor Compound % by weight |
|---|---|---|
| Pure tetra ethyl lead ......... ......... | 61.41 | 61.48 |
| Ethylene dibromide ......... ......... | 35.68 | 17.86 |
| Ethylene dichloride ......... ......... | Nil | 18.81 |
| Dye—(Aviation: Blue Motor: Orange) ......... | 0.03 | 0.06 |
| Kerosine and impurities | 2.88 | 1.79 |
| | 100.00 | 100.00 |

The maximum permissible concentrations of tetra ethyl lead in motor spirit and aviation spirit are respectively 3.6 and 5.5 mls per imperial gallon.

When ethylene dibromide was first used it was added to tetra ethyl lead in quantity equivalent to 1.5 theories or, in other words, about 50% more than the theoretical amount required to combine completely with the whole of the lead present. Later this concentration was reduced to 1.0 theory at which value it has since remained for aviation spirit. For motor spirit however, where a mixture of ethylene dibromide and dichloride is used the equivalent of 1.5 theories is employed i.e. 0.5 theory ethylene dibromide and 1.0 theory ethylene dichloride.

There were very many difficulties to solve after the discovery of tetra ethyl lead, not the least of which was its manufacture in bulk at an economic price; another most important factor was the question of obtaining sufficient bromine. It was thought that bromine might be obtained readily from sea water but since the concentration of this element in salt water is minute, only about 67 parts per million, it seemed at first that the difficulties of obtaining sufficient bromine would be most formidable. However, these difficulties were eventually overcome and today bromine extraction plants are in operation in the United States, Great Britain and on the Continent. At one of the American plants alone a yearly production of 30 million pounds of ethylene dibromide is recorded.

In an attempt to test the theory that bromine extraction could satisfactorily be carried out from seawater a former Great Lakes steamer re-named the s.s. " Ethyl " was converted into a floating factory and cruised in the waters of the Gulf Stream for a week in April, 1925. The results of this floating pilot plant's work proved that the extraction could be made on a commercial basis even although the plant on board only operated for a total of about six hours at a cost of some 60,000 dollars per hour, mainly because all the scientific staff on board were violently seasick. The total cost was therefore somewhere around 360,000 dollars but was evidently well worth the expense and effort to say nothing of the physical discomfort. Obviously the pre-drammamine era!

It is well known that tetra ethyl lead is exceedingly toxic in its concentrated form and can be absorbed into the human system by inhalation and skin contact. It is, however, quite safe and innocuous to the road user when diluted in gasoline. As mentioned before there has continued to be ceaseless research and development to find a still better anti-knock compound than tetra ethyl lead but so far no such effective alternative has been produced. Iron and nickel carbonyls, particularly the former, did reach commercial usage in Germany but only for a short period.

Unfortunately the anti-knock effect of tetra ethyl lead becomes progressively less in increasing concentrations and it is consequently not possible to raise the octane number of a low anti-knock petrol to a high level by the addition of large quantities of tetra ethyl lead. Different basic motor spirits vary widely in their susceptibility to tetra ethyl lead.

One other form of anti-knock agent which is commercially employed in some countries, and which perhaps hardly comes under the nature of the term additive is ethyl alcohol. Queensland, in Australia, is the nearest place to New Zealand in which the use of ethyl alcohol in motor spirit is made mandatory by legislation and the proportion is of the order of 15%. Other countries are South Africa, Brazil, India, Sweden, Switzerland and Cuba; this compulsory use by law is based on the fact that the alcohol is a surplus by-product from other industries and this naturally places a somewhat different aspect on its usage.

## *COMBUSTION CHAMBER DEPOSIT MODIFIERS*

In this category is to be found the most important type of additive next to tetra ethyl lead. For many years there has been a game of leap frog between progress in engine design and progress in fuel quality; each new improvement in fuel quality enabled engine designers to build more powerful and economical engines and when full advantage had been taken by designers of available motor spirit quality a further fuel improvemnt was then needed before another step forward could be taken in mechanical development. Increased octane number prevented engine detonation and so enabled higher compression ratios to be used; the average compression ratio in 1930 was slightly less than 5:1 whereas today the average is at least 7:1 and some cars are now on the road with compression ratios in the region of 8.5:1. There is a resulting desire on the part of engine manufacturers to pursue the same high compression ratio policy to new levels in order to improve fuel economy still further, and such engines would of course require fuels of higher octane quality than is commonly available today in order to avoid detonation. Experience has shown however that detonation is not the only problem in higher compression engines and it is now well recognised that pre-ignition, which often is induced by incandescent combustion chamber deposits, is a problem quite distinct from detonation and much less amenable to treatment by increasing octane quality.

The glowing tendencies of combustion chamber deposits are dependent upon the rapid oxidation of carbonaceous materials under the catalytic influence of metallic salts, and as it appeared possible to hinder this reaction by the use of suitable substances, the Shell Group undertook some years ago an extensive research campaign into the problem, as a result of which it was found that tricresyl-phosphate was a comparatively simple but effective additive for this purpose. It was first introduced commercially in the United States in 1953 and some two years or more ago began to be employed in New Zealand. Since Shell first publicised and patented the use of T.C.P., other Companies sought somewhat similar phosphate type additives which would not infringe the Shell patents, and eventually the Ethyl Corporation launched a product known as I.C.C., and consisting of trichloro-isopropyl-thiono-phosphate. These two additives are the only commercially available materials marketed for this purpose, T.C.P. being retained by patent right exclusively within the Shell Group, and I.C.C. being freely sold to all comers who use it under its own, or identity-masking, trade names. In the early days following Shell's introduction of T.C.P. several United States companies, both major and minor, endeavoured to climb on the band-wagon by publicising extensive claims for this and that ingredient, quite irrespective of whether the " this and that " existed in reality. One such Company launched a full-scale advertising campaign extolling the virtues of their " R.T.G." additive, only to have the ground cut from under their feet by a whispering campaign organised by competitors who learned that the mysterious initials meant nothing more than " Rarin' to go."

In describing the action of organic phosphate additives, I shall be referring more particularly to T.C.P. because that is the product with which I am most familiar, but in principle, at any rate, the Ethyl Corporation product should behave along similar lines.

Two parallel problems were solved at the one time by the use of T.C.P., namely deposit induced pre-ignition and premature spark plug failure; both have become of greater importance with the general increase in compression ratio, and both are caused by deposits. As such they have been a barrier to the development of more powerful and economical engines, and, at least at present, neither problem seems capable of attack either by engine or spark-plug design.

*Pre-ignition*: Pre-ignition means the ignition of the fuel/air mixture by some source other than the spark, which implies of course that it occurs earlier on the compression stroke than the time at which the mixture is normally fired by the spark. It is well known that advancing the spark timing aggravates detonation, and in the same way pre-ignition from an incandescent deposit can either induce detonation or make it more severe. This explanation is one aspect of the way deposits, which build up in a chamber, produce detonation by first causing pre-ignition. However, it is possible to have deposit induced detonation without pre-ignition and a cure for pre-ignition cannot therefore be expected to eliminate detonation produced by deposits in all cases. Although pre-ignition can produce detonation, equally well can detonation produce pre-ignition, because when an engine 'pinks' the temperature in part of the combustion chamber rises significantly and this rise may be sufficient to ignite the deposits and so initiate pre-ignition. Thus the two combustion phenomenon of detonation and pre-ignition, whilst being quite different in character, are mutually provocative. The cure for detonation is higher octane quality fuel and the cure for deposit induced pre-ignition is the use of a suitable additive to stop the deposit from burning.

What appears to happen in an engine is that the lead compounds make the carbon deposits burn at a much lower temperature than would be the case in the absence of lead and this burning or glowing causes pre-ignition. The phosphorus in tricresyl-phosphate combines with the lead and prevents this glowing from occurring by raising the spontaneous ignition temperature.

The effectiveness of tricresylphosphate in modifying combustion chamber deposits is readily visible to anyone who has seen an engine undergoing top overhaul; whereas the combustion chamber deposits in the absence of T.C.P. are invariably black in nature, those modified by T.C.P. are frequently whitish and in physical character are found to be very much easier to remove by mechanical means.

*Spark Plug Fouling.* For many years the problem of spark plug fouling plagued the aviation industry; it not only results in high maintenance costs but is one of the main causes of unscheduled delays. During the last war the problem became particularly severe with certain in-line engines because of the uneven distribution between cylinders of the tetra ethyl lead and the ethylene dibromide scanvenger. One effective solution was to devise means of improving the fuel/air mixture distribution pattern of the engine but another line of attack was to seek alternative halogen scavengers. Work on this latter problem ultimately was abandoned and efforts were concentrated instead on aiming to modify the lead compounds in the combustion chamber chemically and change them to a form which would be much less harmful in their effect upon spark plug efficiency. Just as tricresy-phosphate had been shown to be so effective in eliminating pre-ignition, so it was found to be equally effective in eliminating spark plug malfunctioning problems. Lead deposits identified by X-ray analysis are usually complex combinations of lead, bromine, oxygen and sulphur; these compounds normally constitute from 70 to 90% of the total deposit, the remainder being carbonaceous material. The lower melting point compounds such as lead bromide and lead oxybromides are found on the cooler combustion chamber surfaces and their formation is encouraged by low temperature operation. Lead oxide and lead oxysulphates are formed almost exclusively on high temperature surfaces such as exhaust valves and occsiaonally on spark plug insulators. The widest range of compounds is found on these plug insulators because of the steep temperature gradient along the length of the ceramic portion and the considerable variation of spark plug temperature with power output and mixture strength.

When the types of compounds found upon sparking plugs were examined for their physical and electrical properties it was discovered that under engine operating conditions resulting in high plug temperatures, these compounds lost their electrical resistance and were therefore capable of causing a short circuit when deposited on the plug insulators. Such a short circuit means of course that the engine misfires and loses power. This type of failure commonly occurs during accelerations when the engine temperature rises following periods of low power operation such as town driving (which is conducive to the formation of the compounds of low melting point and low electrical resistance). So long as the plug temperature remains low the resistance of the deposits is high enough to permit a spark to jump the gap, but at high temperatures the resistance decreases and the charge may leak uselessly to earth. Other types of plug failures commonly found are the bridging of the spark gap by flying chunks of deposit, and "tracking" which involves a discharge along the deposit surfaces. It has been found that T.C.P. with its formation of lead phosphate complexes greatly reduces all these types of plug failure. As mentioned before the first application of T.C.P. was in aviation where the problem from time to time was found to be particularly severe and dangerous and where the concentration of tetra ethyl lead in the fuel is the highest. One particularly important use of T.C.P. in aviation spirit was in helicopter operations in Korea where it is not too much to say that its spectacular effect on improved plug life with consequent virtual elimination of engine failures contributed most materially to the war effort in that otherwise, helicopters could not have been used. Now-a-days in the aviation field the use of T.C.P. has to a considerable extent become outmoded because, not only has spark plug design improved immeasurably, but the lead contents of aviation spirits have fallen greatly, in some cases by almost 50%. T.C.P. is however, still used in New Zealand in aerial top-dressing, both in helicopters and conventional aircraft. In the automotive field, the problem is a considerable one and appears to be becoming increasingly so; in its most serious form on the road, plug fouling may occur at between 500 and 1000 miles and it is not uncommon for cases to be reported after 3000 miles. Attempts to solve the problem by using plugs of different heat factor appear, up to the present, to have been generally unsuccessful. A cooler running plug, whilst it reduces the maximum operating temperature, encourages oiling and the formation of low resistance deposits at low power output; a hotter running plug reduces the formation of deposits at low temperatures but aggravates the problem at maximum power.

*ANTI-CARBURETTOR ICING ADDITIVES*

In some overseas countries additives have been introduced in recent years to control the tendency for ice deposits to be built up in carburettors of some types of cars operating under winter conditions with highly volatile fuels. These fuels are of the premium type which, at the present time, are not available in New Zealand.

The formation of ice in carburettors is not at all a new phenomenon and it has been known for very many years in aircraft practice although its occurrence is comparatively rare in automobile engines. In aircraft carburettors, special provision for the application of external heat is embodied in the carburettor design so that icing conditions, when they are met, may be automatically countered. Due to the well-known refrigerating effect induced by the vaporisation of volatile liquids, moisture present in highly humid atmospheres, may, in passing through the carburettor, be cooled so rapidly by the evaporation of the motor spirit that it is reduced to temperatures below freezing point, with the resultant production of ice. This ice can, under adverse circumstances, build up on throttle plates or in choke tubes and if such deposits become sufficiently extensive can cause serious interference with the normal functioning of the carburettor by impeding the passage of the air/fuel mixture. Fortunately many conditions of engine design and operation combine to counteract this tendency towards ice formation and in any case it can only occur under a limited range of atmospheric conditions. Cars and carburettors vary widely in their tendency to produce carburettor ice and in New Zealand at any rate, troubles which may be legitimately laid at the door of icing are virtually non-existent and we would not anticipate them to arise unless very highly volatile motor spirit similar in nature to the overseas premium grades mentioned a little earlier were to be marketed here. Even then it is doubtful if more than a very small proportion of motorists would be affected.

Obviously then the degree to which icing will occur depends to a considerable extent for any given car on both the humidity and the air temperature; it is also dependent on engine speed and load. The particular atmospheric conditions which have been found to be most conducive to carburettor icing are about 40°F. and above 70% relative humidity. Carburettor icing trouble can only occur when the atmospheric temperature is above freezing point because at lower temperatures the atmosphere is already dry.

Summarising the conditions necessary for icing, a quotation from a paper read to the Society of Automotive Engineers in America in 1954 is relevant:—

> "For any given engine a number of things must happen at the same time before stalling due to ice formation can occur. These are:—
>
> (1) The fuel must be sufficiently volatile.
>
> (2) Sufficient moisture must be present in the incoming air.
>
> (3) The ambient temperature must be low enough so that fuel refrigeration lowers the carburettor metal temperatures below freezing.
>
> (4) The engine must be cold.
>
> (5) The engine must be operated in a manner conducive to ice formation and stalling, and, of course, the engine must be one that is subject to stalling in the first place."

Overseas the most popular additive used to combat this problem during the winter months is isopropyl-alcohol, which acts in preventing ice formation by the simple mechanism of lowering the freezing point of the water; thus, although volatility is unimpaired and the temperature drop in the carburettor remains unaltered, no ice forms on carburettor surfaces. In order to be genuinely effective, however, isopropyl-alcohol has to be added in concentrations around 1% and this level is far too high for material of this nature to be considered, on economic grounds alone, in New Zealand.

## LIST OF PAPERS READ BEFORE BRANCHES, 1956-57.

*AUCKLAND:*

| | |
|---|---|
| The Control of Noxious Gases in Chemical Industry | W. S. Damon |
| Some Aspects of Wood Chemistry | C. M. Stewart |
| Textiles in the Home | Dr. J. A. Dixie |
| 10,000 miles of Chemistry, Personalities and Scenery in the U.S.A. | Dr. H. Bloom |
| Chemistry and Nuclear Power | Dr. D. Hall |
| Some Experiments with Isotopes | Dr. A. L. Odell |
| Plasto-Elastomers | W. G. Hardeman |

*WAIKATO:*

| | |
|---|---|
| Experimental Silage Making | Dr. K. Kennedy |
| Some Aspects of Light Leather Manufacture | W. F. Rolt |
| Progesterone Levels in the Blood of the Ewe | Dr. D. G. Edgar |
| Changing Views on Lime Requirements | Dr. E. B. Davies |
| The Bitter Principles in Hops | R. R. White |
| Aspects of Veterinary Toxicology | M. R. Coup |
| X-ray Crystallography | J. White |
| Analytical Application of Atomic Absorption Spectra | J. E. Allan |

*MANAWATU:*

| | |
|---|---|
| Aspects of a Recent Visit to the Soviet Union | Prof. S. N. Slater |
| Photosynthesis | Dr. J. W. Lyttelton |
| Alkaline Phosphatases | Prof. C. R. Barnicoat |
| The Nutrition of the Lactic Streptococci | Dr. H. R. Whitehead |
| Chemistry in Industry | W. A. Joiner |

*WELLINGTON:*

| | |
|---|---|
| Teaching of Chemistry | Dr. B. D. England, E. S. Borthwick, T. A. Rafter, M. F. Woodward |
| Quantitative Infra-red analysis of mixtures of Isomeric or closely related Substances | I. C. R. McDonald |
| A Visit to the University of Moscow | Prof. S. N. Slater |
| The Determination of Alcohol, and the Interpretation of the Results in connection with Driving Offences | Dr. W. H. B. Bull, L. H. Davis, A. E. Forsyth, R. Stacey. |
| Recent Advances in Clay Mineral Research | L. D. Swindale |
| The Metabolism of Cholesterol | A. P. Oliver |
| Motor Spirit Additives | E. S. Borthwick |
| The Ultracentrifuge | Dr. J. Lyttelton, B. J. O'Brien, G. B. Marshal, N. J. Rumsey |
| Recent Research at Victoria College | R. M. Carman, R. T. M. Frazer, J. L. Mansell, R. A. Bell |

*CANTERBURY:*

| | |
|---|---|
| Technological Education | Dr. F. J. Llewellyn |
| Trace Elements — 1956 | A. F. R. Adams |
| The Place of the Biochemist in Agriculture | Dr. R. M. Allison |
| Structure and Reactivity in Organic Chemistry | J. Vaughan |
| Indian Journey | Dr M. M. Burns |
| Industrial Implications of the Health Act | Dr. D. P. Kennedy |

*OTAGO:*

| | |
|---|---|
| A Chemist Looks at Geology | Dr. W. S. Fyfe |
| Chemists and Management | G. W. Broughton |
| Would you have your son a chemist? | Open Forum |
| Problems in Confectionery Manufacture | A. H. Lewin |
| Current Research at Plant Chemistry Laboratory | Dr. A. T. Johns |
| Hazards in Testing Nuclear Weapons | Discussion |

# COUNCIL MINUTES.

## ABRIDGED MINUTES OF A MEETING OF THE COUNCIL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.) HELD IN THE NEW ZEALAND INSTITUTION OF ENGINEERS' ROOMS, WELLINGTON, ON THURSDAY, 6th MARCH, 1958.

*PRESENT:*

Prof. C. R. Barnicoat (President, in the chair), Dr. A. L. Odell (Auckland), Dr. E. B. Davies (Waikato), Dr. W. A. McGillivray (Manawatu), J. R. Beck (Wellington proxy), D. J. Hogan (Canterbury), Dr. A. D. Campbell (Otago) and Dr. W. E. Harvey (Hon. General Secretary). Mr. L. J. Rollo (Registrar) was present for part of the meeting. Apologies were received from Prof. L. H. Briggs (Vice-President) and A. P. Oliver (Wellington delegate).

*CONFERENCE 1958:*

Dr. E. B. Davies reported on the proposed Conference programme Conference will be held from 27th - 29th August and the Council meeting on Tuesday, 26th August. The first circular will be sent out shortly.

*AWARD OF LABORATORY ASSISTANT CERTIFICATE:*

*Resolved.*—That the L.A.C. be awarded to the following, who have completed the requirements for the certificate:—

Frecklington, Miss Fay, Massey College.
MacGibbon, Denton Bryan, Crop Research Division, Lincoln.
Parry, Ronald Irvine, McSkimming & Son Ltd., Dunedin.
Lawson, Bruce Moncrieff, Animal Research Station, Wallaceville.
Cadd, Miss Judith Anne, Animal Research Station, Ruakura.
Fitzpatrick, Michael, Soil Bureau, Wellington.
Roddick, Brian John, Animal Research Station, Wallaceville.

*SUGGESTED AMENDMENT TO L.A.C. REGULATIONS:*

It has been pointed out that under Regulation 2.2.2 a candidate may be accredited with a pass in certain subjects if he has passed these subjects for University Entrance or School Certificate *while registered as a Candidate* for the L.A.C. This provision is not altogether satisfactory but is required by the Public Service Commission. The Examinations Committee will look into the position to see if a more suitable regulation can be introduced.

*A.N.Z.I.C. BY EXAMINATION:*

Dr. Campbell pointed out that the R.I.C. examinations for A.R.I.C. had been modified recently, and suggested that the N.Z.I.C. Regulations should perhaps be modified to bring them into line. The Secretary said that he had had several enquiries from people who may be interested in sitting for the A.N.Z.I.C. examinations and Dr. Campbell reported that the Examination Committee would run the examinations if required.

*JOURNAL:*

The Journal is now issued in envelopes instead of paper wrappers and members expressed appreciation of the change.

Dr. McGillivray stated that in future the size of individual issues of the Journal will vary, but the total number of pages published during the year will remain about the same as previously.

The cost of publishing the R.I.C. Presidential Address was about £30 - £35, and Dr. McGillivray agreed to approach the N.Z. Section, R.I.C. to see if they would be prepared to contribute to this cost.

*LIST OF MEMBERS:*

Dr. McGillivray reported on discussions he had had with the printer as to the cheapest method of publishing a list of members and keeping the list up to date. There are several possible ways, and it was left to the President and the Editor to have further discussions with the printer and to select the best method.

*MEMBERSHIP:*

The following applicants were elected:—

*Fellows:—*

GREEN, Rowland Alfred Weldon, D.Sc., F.R.I.C., Dept. of Chemistry, University of Malaya.

LLEWELLYN, Donald Rees, D.Phil., D.Sc., F.R.I.C., Dept. of Chemistry, University of Auckland

*Associates:—*

ADAM, Marjorie June, B.H.Sc., 60 Rakau Rd., Wellington, E.2., (Chemist, N.Z. Leather and Shoe Research Assoc.).

CURTIS, Anthony John, A.R.A.C.I., 43 Tirohanga Road, Lower Hutt (Works Manager, Lever Brothers (N.Z.) Ltd., Petone).

LONG, Anwyn Margaret, M.Sc., 22 Pilcher Crescent, Lower Hutt. (Research Assistant, Victoria University of Wellington).

SUTHERLAND, Arthur John, Dip.Appl.Chem., 9 Beaumont Grove, Wellington (Chemist, Research Laboratory, Pinchin Johnson & Co. (N.Z.), Ltd).

The following resignations were accepted: Perrin, D.D.; Hurran, W.J. (from 1954).

*SALARIES:*

Dr. Odell reported that Mr. Lambert was prepared to carry out a salary survey should Council consider the time was appropriate. *Resolved.*—That approval be given, for a salary survey to be carried out this year. *Resolved.*—That D. E. Adams and A. G. Frieberg be appointed to the Salaries Committee.

*AUCKLAND DAIRY CHEMISTS' INDUSTRIAL UNION OF WORKERS:*

The Secretary reported that he had not heard from the Union. It was agreed to write to Mr. Udy, who is one of the leading officers of the Union.

*UNION MEMBERSHIP:*

The Secretary reported that he had been informed by a member that there was reason to believe that several Unions may bring pressure to bear on Institute members. The Secretary further stated that the Institute view had always been that no Associate or Fellow should be required to join a Union. However the legal position is not always clear, and Mr. Beck undertook, on behalf of the Wellington Branch, to investigate the general position in detail.

*TIMBER PRESERVATION AUTHORITY:*

The Secretary reported on the meeting that he and Mr. Joiner had had with the Minister of Industries and Commerce. The Minister had asked for the Institute's case to be put in writing so that he could study it further.

*CHANGE OF RULES:*

In accordance with the notice of motion the following changes in the Rules were made:—

Rule 13.2: *Resolved* that Rule 13.2 be amended to read:—

"The President, Vice-President and Honorary General Secretary-Treasurer shall be elected annually from nominations made by Branches or by any six members, and forwarded to the Honorary General Secretary-Treasurer, by 30th September."

An amendment that the words "or by any six members" be deleted proposed by Waikato lapsed for want of a seconder.

Rule 13.4: *Resolved.*—That Rule 13.4 be amended to read:—

"The President and Vice-President shall be members of the Institute."

Rule 13.6: *Resolved.*—That Rule 13.6 be amended to read:—

"If there be more than one nomination for the office of President, Vice-President or Honorary General Secretary-Treasurer, an election or elections shall be held by postal ballot of all members. With the ballot papers there shall be included the names of members or Branches nominating each candidate, and there should be brief biographical notes of the candidates."

**NOTE: There was considerable discussion on this amendment to the Rules. It was pointed out that to ensure continuity of officers as far as possible it is desirable that the Vice-President in any one year be regarded as the President-elect. However it was decided that it was not necessarily desirable to write a provision such as this into the Rules.**

Rule 16: *Resolved.*—That Rule 16 be amended to read:—

"Financial Year. The financial year shall end on the 30th day of April." Auckland opposed.

*NOTE:* Under the terms of a Resolution passed at the last meeting of Council the subscription for the period 1st November, 1957 to 30th April, 1958, is waived.

*TECHNICIAN TRAINING:*

A lengthy discussion was held on the subject of Technician Training, during which members commented on the syllabus proposed by the Auckland group. It is evident that several groups are thinking along similar lines, and it was generally agreed that to spur on discussions with the Education Department it would be necessary for the Institute to take the initiative. Dr. Campbell explained the Examinations Committee's views and it was finally *Resolved.*—That the Examinations Committee, with power to co-opt, be asked to draw up a detailed syllabus for examinations for laboratory technicians on the basis of a 3-year course for the final certificate, with a lower level certificate approximating to the present L.A.C.

The Examinations Committee is to report to Council, and it was understood that the Auckland group would be consulted by the Committee at some stage of its work.

*N.Z. ASSOCIATION OF SCIENTISTS:*

A letter from the N.Z. Association of Scientists asked for the Institute to assist the Association in a campaign to organise technicians as a special class of member within the structure of Association. It is considered that a body such as the Association, consisting of both professional scientists and science technicians, is well constituted to deal with the problem of developing courses of training etc., which would lead to a better understanding and appreciation of the value of science techniians and technologists.

*Resolved.*—That the letter be received.

*U.N.E.S.C.O.:*

Council approved of the appointment of Dr. M. M. Burns to represent the Institute on the Science Sub-Committee of U.N.E.S.C.O.

*CAREERS IN CHEMISTRY:*

The Canterbury delegate reported that the Canterbury Branch was working on the preparation of a booklet dealing with careers in chemistry in New Zealand.

W. E. HARVEY,
*Hon. General Secretary.*

## CONFERENCE 1958.

The Committee hopes that the Hamilton Girls' High School will be available as meeting place for the Conference. This school has an historical association with the Institute as it was the venue of the first Conference in 1935 and of the 1951 Conference.

A three-day programme is being planned from Wednesday, 27th, to Friday, 29th August, this being considered most suitable for all members. The tentative programme is based on the following scheme:—

*WEDNESDAY*—

*Morning*—Greetings, Registration, Opening.

*Afternoon*—Sessions and Annual General Meeting.

*Evening*—Easterfield Address.

*THURSDAY*—

*Morning*—Session.

*Afternoon*—Visits.

*Evening*—Entertainment.

*FRIDAY*—

*All Day*—Sessions.

Most members will have to be accommodated by the three main hotels in Hamilton, the tariff range of these being from £2/10/- to £3/7/6 per day. A limited number can be provided with less expensive accommodation.

# NEWS AND NOTES.

## MANAWATU BRANCH:

A recent visitor to Palmerston North was Sir Harry Jephcott, a Past-President of the Royal Institute of Chemistry. Sir Harry was able to provide the Branch Committee with much valuable information regarding Royal Charter procedure.

## WELLINGTON BRANCH:

Mr. R. C. Bell, previously Chief Chemist and Plant Superintendent, Standard Vacuum Oil Company, has been transferred to Head Office with the position of Chief Chemist and Costs and Methods Manager.

At the first branch meeting for 1958 when Dr. Wilson lectured on Photosynthesis, a much respected member of the Branch was present in the audience. This was Mr. T. A. Glendinning, one-time secretary of the Institute, who became an Associate of the R.I.C. in 1892, Fellow in 1895. He was a foundation member of the N.Z.I.C. (Associate 1931) and is now an Honorary Member.

The following personnel have recently returned to Wellington after overseas study:—

Dr. Peter Grant who studied at Cambridge University. Later experience was gained at an iron and steel works in Turkey and at Nottingham University before returning to the Organic Section, Dominion Laboratory.

Dr. Alec Wilson who studied with Calvin in California. After obtaining his Ph.D. he gained experience of microbiological methods at Stanford University and then did radio tracer work for the Standard Oil Company. He has joined the Nuclear Science Division.

## AUCKLAND BRANCH:

Dr. E. G. Bollard, Fruit Research Division, D.S.I.R., returned in December from the United Kingdom where he had spent two months visiting institutions after completing his Commonwealth Fund Civil Service Fellowship at Cornell University.

## CANTERBURY BRANCH:

Professor J. Packer and Professor S. R. Siemon have been appointed members of a delegation from the University of Canterbury to a Conference in Sydney in June on the peaceful uses of atomic energy.

Mr. H. D. Orchison, Lecturer in the Soils Department, Canterbury Agricultural College, Lincoln, has returned from a period of Refresher Leave in Great Britain.

Dr. C. J. Wilkins and Dr. J. M. Austin of the Chemistry Department, University of Canterbury, have also recently returned after Refresher Leave in the United Kingdom and Europe.

Mr. A. H. Horn, formerly of the Irrigation Research Station, Winchmere, has joined the staff of Canterbury Agricultural College, Lincoln.

Mr. L. F. Phillips, a recent graduate of the University of Canterbury and Assistant Lecturer in the Chemistry Department, has been awarded a Shell Scholarship which he will take up in August at Cambridge.

## OTAGO BRANCH:

It is with regret that we record the recent, untimely death of one of Dunedin's younger chemists, William Vincent Hazelwood, chemist to Cadbury Fry Hudson Ltd. Mr. Hazelwood had been in poor health for some time.

# BOOK REVIEWS

*SOME PRINCIPLES OF ENERGETICS IN BIOCHEMICAL REACTIONS*, by Irving M. Klotz. Published by Academic Press Inc., New York, 1957. 64 and VII. pages. Price 3 dollars.

The author has set out to present in simple terms the principles of energetics which by means of molecular transformations govern biochemical phenomena. By using diagrams, simple biochemical reactions, and physico-chemical formulae clearly arranged and introduced in stages, the writer has introduced the concepts of Laws of Thermodyonics, " Free " Energy, Chemical Potentials, Group Transfers and " High " Energy Bond, and the Molecular-Statistical Theory.

This slender volume fulfills a real need not only among biologists (for whom the book was written) but also for workers in chemical and biochemical fields whose knowledge of higher mathematics is limited.

—C.R.B.

*THERMODYNAMICS FOR CHEMICAL ENGINEERS* (2nd Edition), by Harold C. Weber and Herman P. Weissner. Published by John Wiley and Sons Inc., New York, September, 1957. Price 8.50 dollars.

This is a basic teaching text covering the whole field of what is generally regarded as engineering thermodynamics. As such, it is principally designed for the student of chemical engineering, but should also have interest for the physical chemist. Subjects treated include not only thermodynamic laws, chemical thermodynamics, equilibria, gas laws, etc., but also fluid flow and heat engines, thus relating subjects which in this country are generally considered separately. The authors, both professors of chemical engineering at the Massachusetts Institute of Technology, have related the theoretical aspects of the subject to the practical by the inclusion of numerous worked examples, and sets of problems designed to illustrate rather than provide practice in calculation. The presentation is neither over-simplified nor highly mathematical, resulting in an easily-read volume which at the same time well covers the subject. —D.W.K.

*CAHIERS DE SYNTHESE ORGANIQUE.* By Jean Mathieu and Andre Allais. Vol. 1, 232 pages, 1957, 4200 fr. Vol. 2, 322 pages, 1957, 4400 fr. Vol. 3, 266 pages, 1957 (no price). Paris: Masson et Cie. These three books are the first of a series which will comprise about ten volumes of well-organised information on organic synthetic methods. This information is arranged according to a number of general reactions, e.g. acylation in the aliphatic series, and each section is sub-divided according to the method of achieving the chemical change involved. Examples are given with yields and references. In addition each section opens with a general summary and concludes with complete tables of examples, yields and references. It is a pity that authors' names have been omitted here, but otherwise these volumes have been well produced and can be warmly welcomed as a useful addition to the literature.

The same authors and publishers have also provided a textbook on the principles of organic synthesis on modern lines, which is intended to be an introduction to the series. (Principes de Synthese Organique. 600 pages, 1957. 8500fr.)

—S.G.B.

*THE CARBOHYDRATES — CHEMISTRY, BIOCHEMISTRY, PHYSIOLOGY.* Edited by Ward Pigman. Published by Academic Press Inc., New York, 1957. 902 and XVII pages. Price 20 dollars.

Nineteen American and two European authorities have contributed 15 chapters dealing with: The Monosaccharides, their structure, stereochemistry, occurrence, properties and synthesis, Esters (including inorganic), Glycosides, Acetals, and Thioacetals (240 pages): The Polyols, Acids and Oxidation products, Ethers, Anhydro-sugars, Unsaturated and Nitrogenous derivatives (235 pages): Oligosaccharides, Naturally-occurring Glycosides and Glycosidases (125 pages): The Identification and quantitative determination of carbohydrates (including histochemical methods) (38 pages): Polysaccharides—general, plant and animal (91 pages): Photosynthesis (30 pages): Metabolism of Carbohydrates, Nutrition, including dental aspects (51 pages).

Each subject is introduced with a short historical treatment in order to provide an adequate grounding. The articles are authoritative, comprehensive and succinct, and are well written and readable. There are over 4500 references to original articles, some as recent as the year 1956. In keeping with the high quality of its subject matter, the book is excellently printed and bound. To the reviewer's knowledge it is quite the best manual on the Carbohydrates available in the English language.
—C.R.B.

## BOOKS RECEIVED.

*BIOCHEMISTRY OF SOME PEPTIDE AND STEROID ANTIBIOTICS,* by E. P. Abraham. Published by John Wiley and Sons, Inc., New York, 1957. 96 pages. Price 3.00 dollars.

A second volume in the Ciba Lectures in Microbial Biochemistry series, this text again covers three lectures — the Bacitracins, the Cephalosporins and structural and functional relationships of the Bacitracins and Cephalosporis to other antibiotics. As in the first volume, the work described is mainly that carried out in the author's own laboratory.

*REPORTS ON THE PROGRESS OF APPLIED CHEMISTRY,* Vol. 41, Edited by H. S. Rooke. Published by the Society of Chemical Industry, 14 Belgrave Square, London, 1956. 795 pages. Price £5.

This volume contains the usual valuable selection of reviews under the broad headings of Fuel and Fuel Products, Inorganic Chemistry, Metals, Organic Chemistry, Biological Products, Textiles, Plastics, Adhesives and Paints, Chemical Engineering and Hazards, Agriculture and Food.

*INDUSTRIAL CHEMICALS* (2nd Edition), by W. L. Faith, Donald B. Keyes and Ronald L. Clark. Published by John Wiley and Sons., Inc., New York, November, 1957. 844 pages. Price 16 dollars.

This text covers important economic and technical facts about 140 major industrial chemicals. Information listed includes how each chemical is made, how it is used, quantities produced, price range, important chemical and physical properties, usual grades, how packaged and shipped, who makes it and where, important economic trends.

*QUANTITATIVE ORGANIC ANALYSIS,* by James S. Fritz and George S . Hammond. Published by John Wiley and Sons, Inc., New York, 1957. Price 6.50 dollars.

This is intended as a classroom text and the main stress is on the formulating and explaining of basic principles. Material covered includes acid-base methods, oxidation-reduction methods, spectrophotometric analysis, methods of achieving analytical separations, kinetics, and other methods of quantitative analysis.

*THROUGH ALCHEMY TO CHEMISTRY, A PROCESSION OF IDEAS AND PERSONALITIES,* by John Read. Published by G. Bell and Sons, Ltd., London, 1957. Price 18/6.

A worthy companion to Dr. Read's other well known contributions to chemical literature, this book will have a very wide appeal to pupil and teacher, layman and specialist. It offers an attractive pageant of the leading ideas and personalities of what has been described as "the most romantic of all the branches of science." Written as an absorbing narrative, it ranges from the chemical conceptions of early civilisations, through the age of alchemy, to the benzene ring, electrons, atomic structure, and space chemistry.

All chemists who are interested in the development of their science will want to read this book — it is a literary accomplishment.

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## NEW SCIENTIFIC JOURNALS.

The Department of Scientific and Industrial Research has just issued three new scientific journals: The New Zealand Journal of Agricultural Research, the New Zealand Journal of Geology and Geophysics, and the New Zealand Journal of Science.

These journals replace the New Zealand Journal of Science and Technology which was first published in 1918, by the New Zealand Board of Science and Art. In 1927 responsibility for its publication was taken over by the then recently established Department of Scientific and Industrial Research. The semi-popular type of scientific articles was gradually replaced by articles dealing with original research.

In 1938 the Journal was divided into two sections: Section A (Agricultural) covering papers on agricultural research; and Section B (General) covering all non-agricultural papers. Although this division was continued until last year, it had been obvious for some time that the more specialised nature of many of the papers and their increase in number made further division imperative.

The New Zealand Journal of Geology and Geophysics will cater for all papers on straight-out geology and geophysics, and on technique and equipment for measuring or examining geological material or geophysical phenomena. It will not include metallurgical papers, which will be published in the New Zealand Journal of Science.

The New Zealand Journal of Agricultural Research will provide for all papers on crops (including forests, fruit, and vegetables), pastures, and farm livestock; diseases and pests of these; soils and land use. Papers relating to animals other than farm livestock when these are treated as agricultural pests will also be included in this journal. Other papers on animals will appear in the New Zealand Journal of Science.

Botanical papers dealing with plants of pastures and crops will appear in the New Zealand Journal of Agricultural Research, studies of other plants and regional flora, in the New Zealand Journal of Science. Papers dealing with agricultural aspects of soils will also be included in the New Zealand Journal of Agricultural Research, but those on soil engineering will appear in the New Zealand Journal of Science.

The New Zealand Journal of Science will include, in addition to the papers mentioned above, those of any geological or agricultural products regarded as raw material of industry or in the course of being processed or manufactured. Fruit in cool store is not regarded as being processed, but tobacco being flue cured and hops being kiln dried are so regarded.

## NEW ITEMS — DELIVERY 2-3 MONTHS

### * 40kV Electrostatic Voltmeter Cat. No. 11314.

This instrument gives direct reading up to 40 kV d.c. or 40 kV r.m.s. a.c. regardless of wave-form. The instrument employs a specially designed vane held by a taut suspension of the galvanometer type so that large spacing is assured between the vane and the input electrode. The movement is damped electromagnetically and the insulation has been carefully designed in order to eliminate leakage and discharge errors.

### * High Resistance Test Set Cat. No. 11800.

Completely portable, battery operated test set capable of measuring a wide range of resistances up to 2 million megohms. It is direct-reading with a scale length 3½in. graduated 3-200. There are five ranges 3-200, 30-2,000, 300-20,000, 3,000-200,000, 30,000-2,000,000 megohms.

### * Thermocouple Test Set Cat. No. 7556.

Compact, robust and fully portable. Three instruments are combined to provide all the facilities required for testing thermocouples and their associated indicators, controllers, recorders and alarm relays: they are a potentiometer, a Wheatstone Bridge and potential source, which may all be used separately if required. The circuit and switchgear are so arranged as to provide the most convenient test routine. A reversing polarity switch and thermometer are built into the set.

### * Gas Liquid Chromatography Equipment Cat. No. 11880.

The overall sensitivity is considerably higher than is normally achieved by using a kathorometer as a detector and compares extremely favourably with other commercially available detecting systems. The detector output is amplified considerably by a circuit which is at the same time insensitive to noise, thus giving a high signal-to-noise ratio. In the complete instrument the sensitivity can be switched in steps of 2X, 5X, 10X, to a maximum sensitivity of 12.5 $\mu$V full scale on the recorder.

### * Katharometer Cat. No. 11900.

Thermal Conductivity Cell (in heater), manufactured in copper. Designed for use at temperatures up to 250° C, special P.T.F.E. seals being used. A twin bore type, each bore containing a 0.001 in diameter platinum wire held under spring tension. Both bores have separate inlet and outlet ports of stainless steel for sample and reference gases. A cavity for a mercury thermometer and thermostat is provided. It has been designed to give a high signal-to-noise ratio and to have a good long term stability so that time spent in calibrating is kept to a minimum.

Registered at the G.P.O., Wellington, for transmission by post as a Magazine.